Linear Programming: Formulation

Problem 1

1. A firm produces four products A, B, C, and D. Each unit of product A requires 2 hours of labor and 1 hour of assembly, and costs €10. Each unit of product B requires 1 hour of labor, 3 hours of assembly, and costs €5. Each unit of C requires 2.5 hours of labor, 2.5 hours of assembly, and costs €2. Finally, each unit of product D requires 5 hours of labor, and costs €12.

The firm has 120 thousand hours of milling time and 160 thousand hours of assembly time available. In addition, the firm has available €100,000. Each unit of product A returns a profit of 40€, each unit of product B returns a profit of €24, each unit of product C returns a profit of €36, and each unit of product D returns a profit of €23. Not more than 20,000 units of product A can be sold, not more than 16,000 units of product C can be sold, and any number of units of products B and D may be sold. However, at least 10,000 units of product D must be produced and sold to satisfy a contract requirement.

Formulate the above as a linear programming problem. The objective of the firm is to maximize the profit resulting from the sale of the four products.

Problem 2

W. Orchard has two farms that grow wheat and corn. Because of differing soil conditions, there are differences in the yields and costs of growing crops on the two farms. The yields and costs are shown in the table below.

	Farm 1	**Farm 2**
Corn yield/acre	500 bushels	650 bushels
Cost/acre of corn	100€	120€
Wheat yield/acre	400 bushels	350 bushels
Cost/acre of wheat	90€	80€

Each farm has 100 acres available for cultivation, 11,000 bushels of wheat and 7,000 bushels of corn must be grown. Determine a planting plan that will minimize the cost of meeting these demands. How could an extension of this model be used to allocate crop production efficiently throughout a nation?

Problem 3

A company faces a firm schedule of delivery commitments for a product over the next six months. The production cost varies by month due to anticipated changes in materials costs. The company's production capacity is 100 units per month on regural time and up to an additional 15 units per month on overtime.

Table contains delivery requirements and production costs by month. The cost of carrying an unsold unit in stock is €2 per month. The problem for the company is to determine the number of units to produce in regural time and overtime each month to meet the requirements at minimum cost. The firm has no units on hand at the beginning of month 1 and wishes to have no units on hand at the end of month 6.

	Months					
	1	**2**	**3**	**4**	**5**	**6**
Units	95	85	110	115	90	105
Cost per unit in regural time	€30	30	32	32	31	30
Cost per unit in overtime	€35	35	37	37	36	37

Problem 4

A post office requires different numbers of full-time employees on different days of the week. The number of full-time employees required on each day is given in table.

Days	Number of employees required
Monday	17
Tuesday	13
Wednesday	15
Thursday	19
Friday	14
Saturday	16
Sunday	11

Union rules state that each full-time employee must work five consecutive days and then receive two days off. For example, an employee who works Monday to Friday must be off on Saturday and Sunday. The post office wants to meet its daily requirements using only full-time employees.

The post office wants to minimize the number of full-time employees that must be hired.

Problem 5

You have decided to enter the candy business. You are considering producing 2 types of candies: Slugger candy and Easy Out candy, both of which consist solely of sugar, nuts, and chocolate. At present you have in stock 10,000gr. of sugar, 2,000gr of nuts and 3,000gr of chocolate. The mixture used to make Easy Out candy must contain at least 20% nuts. The mixture used to make Slugger candy must contain at least 10% nuts and 10% chocolate. Each pound of Easy Out candy can be sold €7 and each pound of Slugger candy can be sold candy €9.

Determine how you can maximize your revenue from candy sales.

Problem 6

An investor has two activities A and B, available at the beginning of each of the next four years. The investor starts with €100,000 at the beginning of the first year. Each euro invested in A at the beginning of a year returns 40% one year later. Each euro invested in B at the beginning of a year returns 80% two years later. A third investment possibility C, will become available at the beginning of the second year. Each euro invested in C at the beginning of a year returns 20% one year later. The investor wants to maximize the total amount of money he has available at the end of the fourth year.